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PLANT PROTECTION OVERSEAS REVIEW

A PERIODICAL SURVEY OF NEW DEVELOPMENTS IN THE CONTROL OF PESTS, DISEASES AND WEEDS

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EDITORIAL

AN important feature of this number is the publication of a brief account of the proceedings of the International Conference at Fernhurst in June, accompanied by a condensed version of the address given by Sir John Russell at the opening session. This address has made a great impression in agricultural and scientific circles. It is now published in this abbreviated form, by kind permission of the author, pending its reproduction in full, together with all the papers and discussions, in a special report on the proceedings of the Conference. This will be available from us early in the New Year. To delegates the report will be supplied free of charge. To others the price will be 18s. 0d.

We have been favoured in this issue also by articles from overseas workers on important problems associated with the cultivation of beet and flax in France and tea in Ceylon respectively. These questions are authoritatively discussed by writers with wide experience of the crops under consideration and the protective measures required against pests and diseases.

Fig. 1.—International Conference in Session

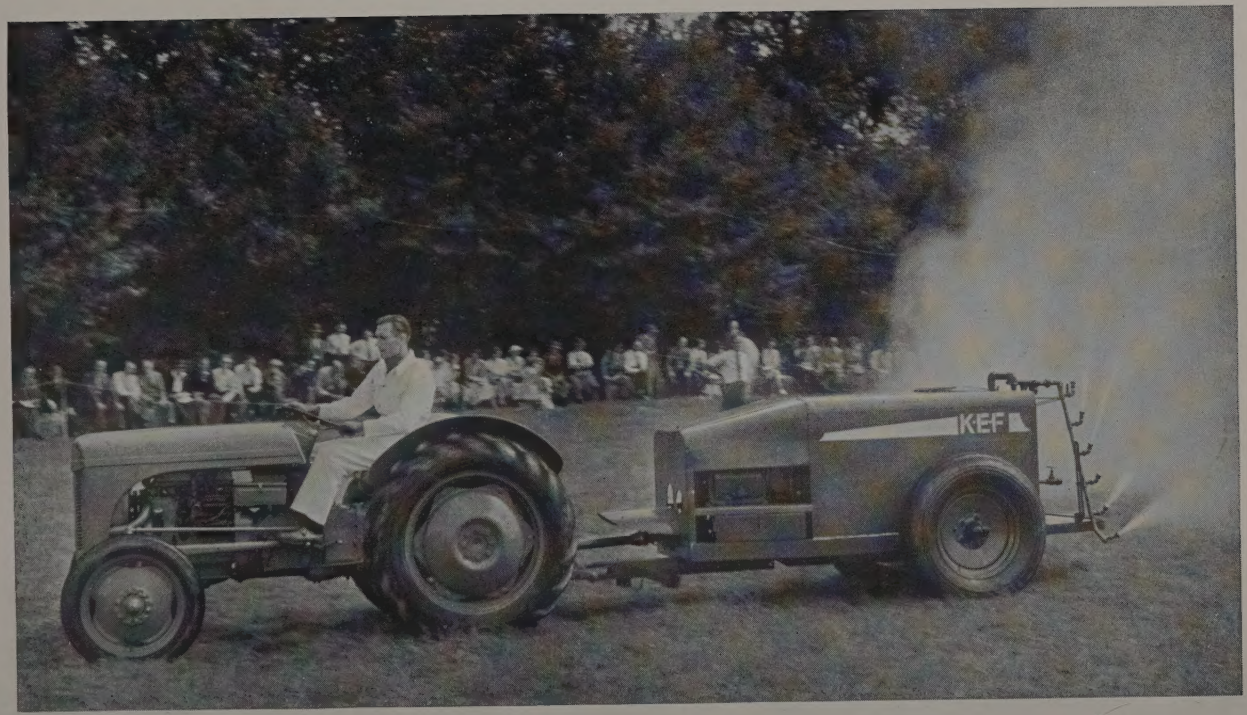

Photo by Chas. White

Fig. 2.—Demonstration of Trailer Sprayer, Kent Engineering Foundry Ltd., during the International Conference

FERNHURST INTERNATIONAL CONFERENCE

By F. G. ORDISH, B.Sc.(Econ.)

AT the Fernhurst Research Station in June this year an International Conference entitled "Some Crop Protection Problems in World Agriculture" was held. Delegates to the number of 158 from thirty-nine different countries attended a full three-day programme of papers and discussions. There have been a number of reports of this event in the lay, farming and technical press, and shortly we ourselves will publish the full Proceedings of the Conference.

We were fortunate in having Sir John Russell as the opener of the Conference, and in this number of the Overseas Review we give a summary of his paper, which is a masterly survey of the field of plant protection, both the present position and the manner in which this has been reached.

The following is a condensed programme of the Conference :—

Monday, 25th June.

Inaugural Luncheon, Dorchester Hotel, London.

Chairman: T. Ainslie Robertson.

Speakers: The Rt. Hon. Sir John Anderson, G.C.B., G.C.S.I., G.C.I.E.
The Rt. Hon. The Viscount Bruce of Melbourne, P.C., C.H., M.C., F.R.S.
The Rt. Hon. The Earl of Listowel, P.C.
Anthony Hurd, M.P.
H. J. Page, C.M.G., O.B.E., B.Sc., F.R.I.C.

Afternoon: Delegates taken to their hotels and Conference papers distributed.

Tuesday, 26th June.

Morning: Paper by Sir John Russell, O.B.E., D.Sc., F.R.S.— "Wastage of World Food Supplies through Pests and Disease."
Chairman: A. Fleck, D.Sc.
Discussion opened by: H. J. Page, C.M.G., O.B.E., B.Sc., F.R.I.C. Prof. R. Rae, B.Agr.

Afternoon: Tour of Fernhurst Estate.
Paper by W. G. Templeman, M.Sc., Ph.D.—
"Chemical Weed Control."
Chairman: W. A. Sexton, B.Sc., Ph.D., F.R.I.C.
Discussion opened by: L. M. Stahler, Ph.D.
F. W. Andrews, D.Sc., A.R.C.S.

Wednesday, 27th June.

Morning Paper by J. F. H. Cronshey, M.A., Dip.Agric.—
"Fungicides, their Development and Uses."
Chairman: John Smith, D.Sc., B.Sc. (For.).
Discussion opened by: P. W. Brian, M.A., Ph.D.
J. Lamb, M.Sc., A.R.I.C., A.I.C.T.A.

Afternoon: Paper by K. M. Smith, D.Sc., Ph.D., F.R.S.—
"Control of Plant Virus Diseases."
Chairman: G. H. Cunningham, D.Sc., Ph.D., F.R.S.
Discussion opened by: F. C. Bawden, M.A., F.R.S.
Roy Markham, M.A., Ph.D.

Thursday, 28th June.

Morning: Paper by E. Holmes, Ph.D., M.Sc., F.R.I.C.—
"Factors limiting Crop Protection Progress."
Chairman: Sir Harold Tempany, C.M.G., C.B.E., D.Sc.
Discussion opened by: Prof. G. Goidanich.
R. Poutiers, M.D., Lic.-es-Sc.

Afternoon: Demonstration of crop spraying and dusting machinery by the leading British manufacturers.

Evening: Farewell dinner, Lion Hotel, Guildford.

Friday, 29th June.

The delegates dispersed. A number of them visited the I.C.I. stations at Jealott's Hill and Hawthorndale.

The various Conference papers, with the exception of Sir John Russell's, were printed and distributed to the delegates before the Conference proper began; the object of this was to leave as much time as possible for discussion at the Conference itself, and the system worked out very well. The procedure was for the author of the paper to speak for a few minutes, summarising or emphasising his main points, and he was then followed by two delegates, who spoke consecutively from prepared notes on the theme; the meeting was then thrown open and delegates spoke from the floor. This method ensured a lively exchange of views, which added to the interest of the proceedings.

The conference languages were English, French and Spanish, and the papers were distributed to the delegates in one of these at their choice. From time to time during the discussions a summary was made in French in one corner of the room for those who desired it. English and French summaries were also made of the remarks of speakers in Spanish and Italian.

As is frequently the case in such meetings, as much information was exchanged between delegates outside the conference hall as in it, and many old friends were re-united as well as a number of new friendships formed. Much useful information was thus exchanged, which should enable progress to be made in the control of insects, mites, viruses and diseases of crops, and thus assist in the looked-for increase in world food production.

In this short article we will not attempt to summarise the papers and discussions, because, as we mentioned above, the full proceedings will shortly be published, but we can give some general impressions and the main lessons that the writer at any rate drew from the conference. They were :—

1. Pests and diseases undoubtedly cause big losses of crops, but there is not sufficient information available as to the amount of the losses.
2. World food production must be raised, and more and better plant protection, particularly in peasant and tropical agricultures, will greatly assist this end.
3. All methods of control have their uses—resistant varieties, parasites and predators, mechanical and cultural methods, and sprays and dusts. The most advantageous procedure may combine several methods—for example, a spray may be used whilst a suitable resistant variety is bred.
4. There is too much consideration of crop losses in separate compartments such as entomology, viruses and fungi. Ecological studies have been started by the entomologists, but the study of crop losses should be viewed as a whole, which is the full ecological approach. Such a study might well be made or co-ordinated by the economists. On the farm, as Dr. Galley said, there is room for the equivalent of the general medical practitioner.
5. The present active co-operation of official research and advisory bodies, farmers and the insecticide industry is the best method of reducing crop losses, and the present happy position is in strong contrast to that of twenty years ago.
6. As regards the chemical control of pests and diseases, there is considerable progress still to be made in the field of application machinery.

We are glad to be able to say that the conference appeared to go with a swing, and our many guests have expressed themselves as very satisfied with it. We think the big value of such a meeting is that it helps to achieve the object we all have in mind, namely the progress of agriculture by means of the mastering of pests, diseases and weeds.

Summary of a paper by Sir John Russell,
O.B.E., D.Sc., F.R.S.

"WASTAGE OF WORLD FOOD SUPPLIES THROUGH PESTS AND DISEASES"

Read at the International Conference, Fernhurst, June, 1951

INTRODUCTION

PLANT protection is of growing importance because the steady expansion of the world's population and the continued loss of land due to natural causes and its conversion from agriculture to other uses make the serious problem of the world food situation more and more difficult.

The losses caused by plant diseases and weeds can only be estimated approximately. A figure of ten per cent is very frequently quoted, but it has no statistical basis. In countries of less advanced agriculture the losses are almost certainly higher than in Great Britain, and a fair estimate of such losses in many other countries would be twenty or more per cent of a healthy crop. Estimates of this kind may be crude, but they have a certain value in that expressed in money terms they may induce hesitating Ministers to sanction activities that ought in any case to be undertaken, and the losses as estimated are usually of the same order as the estimated shortage of food supplies.

PHYSIOLOGICAL DISEASES

At present the most important physiological diseases of plants are those due to deficiences of trace elements such as boron, copper, manganese, molybdenum and zinc, the symptoms, methods of diagnosis and treatment of which are now being worked out. When the deficiences are remedied, land previously unproductive produces good crops.

PATHOGENIC ORGANISMS AND PESTS

Cultural Methods of Control

The effect of pathogenic organisms and pests on the plant often depends on the conditions of growth. Any cultivation or manurial device that upsets the inter-relation of plant and organism protects against attack. Such devices include :—

(*a*) Early sowing of oats to avoid fritfly.
(*b*) Cutting back of grass a few weeks before flowering to control gall midges.

(*c*) Breeding and cultivating of early ripening crops to avoid pests.
(*d*) Manuring of crops to increase their resistance to attack.
(*e*) Destruction of infectious material.

Cultural methods of controlling pests and diseases will be greatly strengthened when it becomes possible to forecast the probability of a great increase in numbers of a particular insect from a study of the preceding weather conditions, such as C. B. Williams has been doing. Forecasting of the best dates for spraying has long been done for the fruit growers of South-East England by Dr. A. M. Massee.

Varietal Resistance to Disease.

The long known difference in susceptibility to disease of different varieties of the same crop has been utilised in three ways for plant protection :—

(1) Seed or tubers from healthy plants growing among a diseased crop are selected and grown again for a few generations to ensure that the plants really are resistant to the disease. By this means varieties of potatoes immune to Wart Disease were found in 1908, and from these new ones have been raised by plant breeders.

(2) A resistant variety is imported from another country, a classical example of which method is the importation into France of American vine root stocks resistant to *Phylloxera* in the 1870's and 80's.

(3) By cross breeding resistant with non-resistant varieties possessing the other properties desired. This, the most certain method, was developed in Great Britain by Rowland Biffen, who produced Yellow Rust (*Puccinia glumarum*) resistant Little Joss wheat, the first instance in this country (England) of building up a new variety by assembling in one plant desirable characters from other sorts.

Resistance to disease, however, is not usually a single Mendelian character, as is resistance of wheat to Yellow Rust, and is rarely complete, because it usually depends on numerous morphological and physiological characteristics of the plant.

The Black Stem Rust of wheat (*P. graminis*), from which Great Britain is practically free, presents more serious and difficult problems. In 1916 it was estimated to have destroyed 280 million bushels of wheat in Western Canada and the United States, and it has caused severe losses in other countries. The pioneer work of E. C. Stakman in Minnesota, followed by work at Winnipeg, showed that the fungus existed as different varieties and as different physiologic races in each variety. New races are continually being produced, which greatly complicates the plant breeder's work, but the Canadian and Minnesota plant breeders have produced and are producing new varieties of wheat resistant to previously known races of the fungus and to other races as they arise.

Control of Potato and Hop Diseases

The potato crop, which, under diverse conditions, produces twice as much food per acre as grain, is subject to a large number of diseases and pests,—fungus, insects and virus—and to physiological troubles as well. Among the diseases is that caused by the fungus, *Phytophthora infestans*, which resulted in the Irish famines of 1845 and later years. Though control subsequently became possible by spraying with a copper compound, plant breeders have long been trying to produce resistant varieties of potato, in which work R. N. Salaman is the pioneer in Britain. He eventually produced a variety resistant to blight and wart diseases, tolerance of virus diseases and with good field and table qualities. The work has been continued by W. Black at Corstorphine, who records that in four generations of breeding from a wild *Solanum* a potato variety has been produced combining field immunity, or high resistance, to three blight strains, to wart disease, several strains of mosaic disease, leaf roll, scab and storage diseases, with good cropping capacity and cooking qualities. E. S. Salmon has produced hybrid hops so tolerant to mosaic that the presence of the disease results in no loss of crop.

VIRUS DISEASES

The fundamental investigations of Dr. Kenneth Smith and Mr. Bawden at Cambridge and Rothamsted on the nature and properties of the different viruses and their relations to the plant must in the end furnish the best means of control of this type of disease, though in the meantime much can be done to evade the virus diseases by using only clean seed or stocks, like the virus free stocks of potato built up by Salaman at Cambridge and the clean strawberry and raspberry stocks produced by the East Malling Research Station, in spite of the occasional appearance of new virus strains to which resistant varieties may succomb in some instances.

BREEDING FOR RESISTANCE TO INSECTS

Plant breeding against insects has been exemplified by :—

(*a*) the breeding of apple stocks resistant to Woolly Aphid by R. G. Hatton at East Malling and M. B. Crane at the John Innes Horticultural Station in England,

(*b*) the breeding of cotton strains resistant to Jassids together with resistance to Black Arm and Leaf Curl by R. D. Knight in the Sudan, who hopes to add valuable cropping and spinning qualities.

CHEMICAL CONTROL OF PESTS AND DISEASES

Modern chemistry has provided many powerful agents for killing harmful organisms and insects, though the injudicious application of chemicals may be followed by undesirable secondary results due to upsetting of the equilibrium between the insects and their surroundings.

Treatment of grain either before sowing or in storage is the simplest example of protection by direct killing of an injurious pest. Smut fungi borne externally on seed corn were first controlled by copper carbonate dusts, and later by dusting with the much more effective organic mercury compounds. Even where preservation of grain in storage is perfect, however, the grain may be affected by some chemicals.

BIOLOGICAL CONTROL OF PESTS

The gentlest method of dealing with the living plant in its relation to the population of mixed insects in the field, orchard or the glasshouse is to encourage, where practicable, the parasites or predators of the harmful insect. Unfortunately, successes are comparatively rare.

USE OF ANTIBIOTICS

The antagonism of some saprophytic forms to pathogenic soil fungi may be used to control the latter by stimulating the saprophytic forms to multiply and so starve or asphyxiate the pathogens, or by using the antibiotics produced by some of the organisms against the injurious ones.

LIMITATIONS IN THE USE OF CHEMICALS

Though chemical control of fungi and insects can be complete difficulties may arise through injuries to the host plant, especially when in leaf, from the material used being, in some cases, greater than would result from attacks of the pests. Vegetable insecticides, such as pyrethrum, derris, nicotine, quassia, etc., are valuable in that they are toxic to certain insects but harmless to plants and domesticated animals. They are, however, limited in their application, chemical substances offering much wider scope. The early chemicals used were simple inorganic compounds of copper, arsenic or sulphur but great advances have been made in recent years by the introduction of complex organic compounds, made on a large scale, and some of which are able to kill almost any insect or fungus. Improvements of copper and sulphur fungicidal sprays and dusts continues but greater progress has been made with mercury organic compounds in this field. The most spectacular advances have been with the insecticides such as the Swiss product, DDT, and the British gamma isomer of benzene hexachloride (BHC), which may prove the more generally useful. Among the still more potent insecticides, which are becoming available, are the organic phosphorus compounds, *e.g.* parathion, which are extremely toxic to insects and mites resistant to many other insecticides, but may be harmful to men and domestic animals. Proper precautions must, therefore, be taken in using them.

APPLICATION METHODS

Great advances have been made in the means of application of insecticides and fungicides. These include the introduction of low volume sprayers, which has greatly reduced the quantity of material needed and increased its potency, and a great extension of spraying by expert contractors.

SOIL INSECTICIDE

The new materials have at last provided an effective soil insecticide for field use, especially for the control of wireworm, against which BHC has proved effective on the farm. BHC can also be mixed with an organic mercury compound and used as a seed dressing against both wireworm and seed-borne fungi.

SYSTEMIC INSECTICIDES AND FUNGICIDES

Entirely new possibilities of control have been revealed by a group of organic phosphorus compounds, known as systemic insecticides, which are absorbed by the plant and render the sap poisonous to insects that can damage the plant, but do not affect the natural enemies of the pests. These systemic insecticides may provide a means of controlling virus diseases transmitted by aphids, though the presence of the chemicals may be objectionable or harmful if the plant is to be used as human or animal food. Great care is, therefore, necessary in their use.

S. H. Crowdy and R. L. Wain have demonstrated systemic fungicidal activity in compounds similar to active plant growth regulators which are of great value as herbicides against broad-leaved weeds in cereals and in meadows, reducing the need for weedkilling cultivations.

INCREASE IN INCIDENCE OF PESTS AND DISEASES

Though the present century has seen an unprecedented increase in our knowledge of insect and fungus pests and in the means of combating them there has also been an enormous increase in the number of pests and in their recorded prevalence. This is to some extent due to closer observation and better diagnosis, but there are other factors involved.

A pest or disease may be introduced from one country into another where it may cause serious damage to crops whilst being comparatively inconspicuous in its country of origin.

An introduced crop may suffer from an insect or disease harboured in an obscure form by a native crop, which may therefore have to be sacrificed.

An introduced insect may displace a native one that has been keeping down a pest, so enabling the latter to damage the crop.

Changes in agricultural practice may alter the balance of insect populations and cause one or other to change its habits and become a serious pest, or may give rise to conditions favouring the spread of a disease organism.

The modern tendency of larger scale cultivation of particular crops, such as occurs in North America, favours accumulation of their pests, insect predators and parasites being encouraged by small fields with hedgerows and road-side verges.

NEED FOR WIDER ECOLOGICAL STUDIES

Dr. Wigglesworth has emphasised the need for fuller study of the effects of insecticides on the whole insect population, and for developing biological methods of maintaining a proper balance in the insect population. In association with East Malling he is studying the inter-relation of the pest or disease organism concerned with the host plant rather than searching for remedies for particular pests and diseases, important though these remedies are. Plant protection is recognised as requiring the widest ecological studies to determine the probable ultimate effects of treatments.

Under present conditions high crop yields are vital, and in striving to attain these nature's balances are continually being upset. We must learn all we can about the plant in health and disease and study fully the relations between the various organisms so that the ill effects attendant upon the upset of some delicate balance may, as far as humanly possible, be avoided.

Translation

ATOMISATION (LOW VOLUME SPRAYING) AND WEED CONTROL IN FLAX

An account of experiences in France.

By J. THENARD,

Technical Department, SOPRA—Société pour la Protection de l'Agriculture—France

In common with all articles published in "Plant Protection Overseas Review," the views expressed are those of the author and are not necessarily endorsed by the publishers.

The results of experimental work in Britain have shown that low volume application of MCPA is unsafe on flax crops. We are, therefore, unable to recommend to British flax growers this method of weed control.

IN the first place, what is meant by atomisation ?

It seems that the term is applied by some specialists to the production of a spray by machines in which air pressure is used to ensure distribution of the liquid, be it insecticide, fungicide or weedkiller, in exceptionally fine droplets.

At the same time it must not be forgotten that other types of machines of American, British or French manufacture produce similar results by forcing the liquid at relatively low pressure through extremely fine jets.

In order to reach universal agreement on this matter we think it would be much wiser to call such machines " des vaporisateurs à grand travail," because real atomisation, in the strict sense of the term, is far from achieved by them.

Since the introduction of selective weed killers into France great progress has been made. Research has shown that they can be used on some crops without causing damage if careful attention is given to the correct rates and times of application. Weed control in flax has been achieved during the past three or four years by hormone weed killers applied at low rates from high volume sprayers (800 to 1,000 litres of water per hectare).

Official organisations and the manufacturers of insecticides and agricultural chemicals have always advised against the use of atomisation, or low volume spraying, on flax. We have searched French records to discover the reasons for this advice and have tried to find out if reliable trials have been undertaken to justify the prescription of low volume spraying on this crop. We must confess that our efforts have been unsuccessful, except for the discovery of records of occasional ill effects from the use of oil soluble hormone sprays. It has always been considered that there would be a great risk of causing serious damage to flax by the use of atomisation, or low volume spraying, of hormone weed killers on this crop.

In 1951, more than 1,000 hectares of flax were treated with MCPA, using French spraying machines of the low pressure atomiser type, delivering only 80 litres of liquid per hectare. The rates of application of active product per hectare varied from 100 to 300 grm. The flax was treated when the plants had attained a height of about 12 to 30 cm.

We have been unable, in the course of numerous trials on flax 8 to 10 " hands " high, to find the slightest ill effect on the fibre. From time to time a stem has been found distorted so slightly as to be almost unnoticeable at 10 or 15 cm. above the collar. The fibre was not brittle and lost no value as merchandise. Such curvature has also been found when flax was treated at the rate of 1,000 litres per hectare.

The extent of the areas treated this year shows that, contrary to what was feared, flax can be weeded with certain hormone type weed killers applied by low volume sprayers.

We have not experimented, or seen the results of the experiments of others, with high pressure atomisers, and therefore, are unable to generalise at present on the possibilities of weeding flax with all types of low volume sprayers.

Flax growers in France will thus be able to treat their fields in 1952 with the aid of this new technique and should obtain excellent results. If speed of application and the minimum requirements of water are considered, we do not doubt that the interested flax growers will be numerous.

It should be noted that this type of machine has many uses, *e.g.*, weed control in cereal crops and pastures, and insecticidal treatment of flax, rape and potatoes.

We have discussed trials with 80 litres of liquid per hectare (some of them with only 40 litres per hectare), we have seen fields treated also at the rate of 200 litres and 450 grm. of active material (MCPA) per hectare. No deformity involving the slightest reduction in the quality of the fibre has been observed. A great step forward has thus been made.

It is necessary to make a distinction between the various hormone products on the market. All are not suitable for the purpose described above.

We can classify them in three categories :—

(1) Oil soluble hormones—definitely not recommended.

(2) Sodium salt of 2,4-D (2,4 dichlorophenoxyacetic acid)—to be used only on crops for seed production.

(3) Sodium salt of MCPA (2,methyl-4,chlorophenoxyacetic acid) —the only product recommended on flax for fibre production.

COPPER FUNGICIDES IN THE CONTROL OF BLISTER BLIGHT OF TEA IN SOUTH INDIA

By PETER de JONG

(*Chief Scientific Officer, United Planters' Association of S. India*)

INTRODUCTION

BLISTER BLIGHT, a fungus disease attacking the young leaves and shoots of tea bushes, is caused by the fungus *Exobasidium vexans* Massee, and is no new disease. It was reported in Assam at the end of the last century and has been noted on tea in N. E. India annually, though, except on isolated occasions, never in epidemic form. In North India the climate and growth pattern of the tea both impose a natural check upon the course of the disease.

Not until 1946 was the disease reported in S. India, when it was first observed in Tranvancore, but it then spread with extreme rapidity on the prevailing winds and by 1947 all South Indian tea districts reported severe attacks, and the disease had spread abroad as far as Ceylon and Sumatra.

The young vegetative shoots of the tea bush provide the crop which is taken for manufacture and it is this succulent plant material which is susceptible to infection. Airborne spores landing on the surface of young leaf or stem tissue germinate, if conditions of temperature and moisture are favourable, and penetrate the tissue. Thereafter the fungal mycelia multiply rapidly within the leaf tissue and the area of leaf about the point of infection assumes a translucent appearance, the upper surface of the leaf becoming indented and the lower surface protruding to form the so called ' Blister.' (*See Fig.* 4.) After a few days the cuticle of the undersurface of the leaf ruptures revealing a white velvety mass, the *hymenium*, on the surface of which spores are found in very large numbers. The ' blisters ' soon dry up and turn black, the necrotic areas sometimes falling away. They are usually irregularly circular in shape and may be up to 15 mm. in width.

The infection of the young leaf is serious both from the point of view of the destruction of actively synthesising plant material and from loss of crop and reduction in quality of the leaf for manufacturing purposes ; but, even more significant from the point of view of loss of crop, is stem infection, which causes whole shoots to die and drop off, and restricts the growth of secondary shoots.

Fortunately stem infection is not a normal feature of an attack until leaf infection has built up to a very considerable extent. Under favourable conditions of moisture and temperature a spore will germinate and penetrate the plant tissue within 8 to 12 hours, after which neither external conditions of climate nor the application of standard fungicides can interrupt the course of the disease. The period from infection to sporulation varies from two to three weeks, the average being about 18 days.

For a number of reasons it has not been found possible to determine accurately the amount of crop lost through attack by this disease, but there is little doubt that in some badly affected districts the losses may range from 15—25% of the annual crop. More serious perhaps than the actual loss of crop, which is reflected in reduction of revenue and higher costs of production, is the insidious capital deterioration which must occur, and is indeed already manifest in some areas, when bushes are subjected to repeated attacks by the fungus, which not only damages and destroys leaf intended for market, but also that leaf which is to be left to develop into a cover of foliage upon which the bush depends to synthesise the carbohydrates so vital for the maintenance of growth and indeed life. In certain areas where BLISTER BLIGHT attacks have been superimposed upon a series of otherwise adverse conditions, lack of carbohydrate reserves has been the direct cause of much of the tea dying out or failing to recover from pruning.

Early Methods of Control

The disease makes its appearance in periods when the climate is characterised by high humidity and moderate temperature, heavy dews and mist belts being as important from the point of view of humidity as actual rain. Immediate steps taken to control the disease included the reduction of shade cover provided by trees and green manure shrubs, in order to increase direct insolation and permit the entry of wind, thereby reducing humidity, and the alteration of pruning times so that recovery from pruning with its attendant prolific growth of young susceptible material should take place in the dry weather, when chances of severe disease attack were at a minimum.

In some areas the alteration of pruning time could be regarded as being beneficial to the tea, but in others such a change in programme caused not only an additional reduction in crop, through bushes being out of plucking during periods of rush growth, but increased the amount of damage from branch canker, as the bushes had to be pruned during the hot dry period, thereby exposing the frames of the bushes to the direct rays of the sun.

Initially the use of fungicides to combat the disease was restricted to seedling nurseries and, in some cases, to areas of tea recovering from pruning which were threatened with attack. The difficult terrain and the type of planting, in which large blocks of tea interspersed with shade trees are served only by narrow paths and

infrequent roads, coupled with the fact that the disease makes its appearance during the monsoon when high winds and heavy rain give rise to conditions usually considered unsuitable for spraying or dusting operations, all weighed against the possibility of adopting large scale chemical methods of crop protection. In addition to the practical difficulties in organising the field scale application of fungicides over extensive areas and the chance of such fungicides adversely affecting the quality of the manufactured tea, a further argument was advanced against the practicability of chemical control. At the time it was believed that the fungus invaded the plant through the stomatal openings on the undersurface of the leaf and therefore any spraying or dusting operations would have to be directed against these areas, which would immeasurably complicate and restrict methods of application. It was also hoped that the recurring periods of hot, dry weather might prevent a carry over of the disease and cause its disappearance after a couple of years.

Early Trials with Fungicides

Shortly after the first outbreak of the disease, field trials were commenced with familiar fungicides to investigate their value in the control of BLISTER BLIGHT on tea recovering from pruning and in nurseries. The following extracts from the Annual Report of the Scientific Department of United Planters' Association of Southern India, 1947-48, summarise the position at the end of the 1947 monsoon period :—

" The experiments were confined to protecting the nursery plants and to protecting pruned tea in the period between bud-break and tipping. *The results show that regular and careful spraying will produce a sufficiently high degree of protection to tea nurseries and prevent any serious damage or stunting growth.* (Italics mine, P. de J.). In the case of pruned tea the experiments put spraying to the severest possible test as the area chosen was pruned at a time such that bud-break would occur in S.W. monsoon when conditions are highly favourable to the pathogen. No spraying was done until three months after pruning. All new shoots which had developed during this period were killed by BLISTER BLIGHT, but as soon as spraying commenced growth in the sprayed plots developed with only minor injury and the tea in sprayed plots was back in tipping in the normal time . . . Sufficient information has been obtained to suggest that a spray compounded of 2 to 4 ozs. of ' PERENOX ' (or its equivalent in other Copper sprays) in 10 gallons of water applied at intervals of 7—14 days, according to the state of the weather, is a working basis. The indications are that the addition of ' Albolineum' in the ' PERENOX ' spray imparts greater protection against infection."

An indication of the efficiency of spraying with ' PERENOX ' is given by the following figures :—

Yield in lbs. green leaf, November 1947—March 1948.

Sprayed area	410 lb.
Unsprayed area	117 lb.

Average number and % of disease-free and infected shoots, 7th October—20th November, 1947.

Sprayed area (62 bushes)—4790 shoots—68.4% free of infection
Unsprayed area (62 bushes)—3353 shoots—9.3% free of infection

It was further stated in the Report that the amount of spray fluid found to be adequate ranged from 25 gallons per acre in the early stages of leaf growth to 75 gallons per acre when the bush had attained a state of full canopy.

By March 1948 there was no escaping the fact that BLISTER BLIGHT had become firmly established in South India and earlier hopes that the annual spells of dry weather would eradicate the disease proved unfounded. It now became necessary to face squarely the problem of disease control on tea in plucking.

Recent Trends in Crop Protection

Throughout 1948 and 1949 attention was given to the possibility of protecting tea in plucking by methods of agricultural control, as it was considered both uneconomic and impracticable to protect such tea with fungicidal sprays. The problem of efficient spray application on the undersurfaces of leaves, an adequate supply of water for spraying operations, labour requirements and also the problem of toxic hazard associated with the use of copper fungicides, largely diverted attention from chemical methods of control. However, the 1949 season showed that if crop loss and capital deterioration were to be further avoided more attention would have to be given to this important aspect.

By this time, investigations at the Tea Research Institute of Ceylon had disclosed that the bulk of leaf infection occured not through the stomata as earlier believed, but through the cuticle of the upper epidermis of the leaf; this development, by diverting attention from the necessity of concentrating on the undersides of leaves during spraying, opened the way for other methods of fungicidal application. The possibility of spray application at low volume rates with batteries of pressure-retaining knapsack sprayers and of power dusting came to the fore.

Power application of insecticides in dust form to control the Tea Mosquito (*Helopeltis* spp.) had already been practised in Central Travancore as early as 1947, and the Scientific Department of the U.P.A.S.I. decided to apply the same technique to the application of copper-based fungicidal dusts. In 1950 with the co-operation of Messrs. Imperial Chemical Industries (India) Ltd., who specially formulated a number of 'PERELAN' type copper fungicidal dusts, a trial was started to determine the effects of repeated applications of copper dusts on the quality of manufactured tea, the extent of toxic hazard, if any, and fungicidal efficiency. The selection of dusts containing 5, 7½ and 10% metallic copper and rates of application of 15, 25 and 35 lbs. per acre were quite empirical and at the end of

Fig. 3.—*Power Dusting of Tea. Central Travancore, 1947*

Fig. 4.—Blister Blight of Tea. Leaf and Stem Infections

the season the trial had demonstrated that, within the limits imposed by the small-scale nature of the experiment, dusts could be applied throughout the monsoon and give an adequate degree of protection without affecting the quality of the manufactured tea and without raising the copper content of such tea beyond an acceptable limit.

At the same time, investigations into the fungicidal values of a number of different formulations, both copper-based and of " non-metallic " type, demonstrated that those fungicides containing copper were so far the most efficient in controlling infection, and of the series tested ' PERENOX ' at either 2 or 4 ozs. in 10 gallons of water was superior to other copper compounds of equivalent copper content. (*U.P.A.S.I. Sci. Dept. Annual Report*, 1950/51.)

At the end of 1950, as a result of representations by the various Research Institutes of the tea industry, the United Kingdom authorities announced a temporary tolerance limit of 150 ppm. for copper residues in manufactured tea. This further cleared the way for field scale applications of copper fungicides. Investigations in Ceylon, carried out by the Tea Research Institute, demonstrated conclusively that under the S.W. Monsoon conditions of 1950 protection of tea in plucking was an economic and practical proposition. An area of 200 acres of tea was given spray protection throughout the S.W. Monsoon, using a solution of 4 ozs. of ' PERENOX ' in 10 gallons of water applied at 12 to 18 gallons per acre by batteries of pressure-retaining knapsack sprayers at regular intervals of 7 to 10 days. The application of the fungicide immediately after leaf had been plucked ensured that by the next round of plucking excess copper had been washed from the leaf by the rain and in no case did the copper content of tea manufactured from this experimental area rise to within 60% of the permitted limit of tolerance. At the same time other trials in Ceylon confirmed in part our own observations in South India that large scale protection of tea in plucking by the power application of copper fungicides in dust form showed considerable promise as a practical and efficient means of crop protection. (Tea Quart. Vol. XXI, Parts 2, 3 & 4).

The 1951 monsoon season will provide an opportunity for further field investigations into various aspects of chemical methods of crop protection. A large-scale trial of power-dusting using a specially formulated 4% ' PERELAN ' type dust is part of the programme, as is a comparative trial on the respective values of dusts and sprays in protecting tea recovering from pruning. Low-volume spray applications of ' PERENOX ' at both 2 and 4 ozs. in 10 gallons of water are to be matched against the 4% ' PERELAN ' dust and other dust formulations and at the same time a trial of comparative fungicidal efficiency will assess relative values of a number of formulations, including ' PERELAN ' type 2% and 4% dusts and 2% and 4% Copper oxychloride dusts specially formulated by Messrs. Imperial Chemical Industries (India) Ltd.

The results of this year's programme of experiments will add much to our knowledge of the difficulties attendant upon large-scale field applications of fungicidal dusts and sprays during the extreme conditions of climate imposed by both S.W. and N.E. Monsoons, and it is devoutly to be hoped that these results will indicate that during the last 2 or 3 years we have progressed some way along the road towards the goal of efficient and economic control of the BLISTER BLIGHT disease of tea.

Translation

THE PRODUCTION OF SEGMENTED BEET SEED

By J. THENARD

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THE question of the monogerm seed of beet was first studied in Europe, but in recent years it has been the Americans who have perfected the preparation of the segmented seed on an industrial scale and have used these seeds extensively.

This involves the segmenting of the seed clusters of beet into sufficiently small parts so as to produce a product containing a high proportion of monogerm segments, that is, each containing one kernel only.

To what stage of development has the preparation of this segmented seed reached, and what is the method which has been used up to the present?

One of the methods used in France was copied directly from that used by the Americans and the machines are very nearly the same. However, it must be admitted that this process is not the only one which might prove successful and that it is possible that some other method of preparation would give equally good or better results.

The first machine through which the seeds are passed is the "segmenter." The main feature of this machine is a coarse grained revolving emery wheel facing a steel anchor-plate, both being enclosed in a casing. The process of segmentation is carried out by forcing the seed clusters between the wheel and the anchor-plate. The seeds tend to break more or less along their natural cleavage lines or they are crushed. Therefore the product which is produced from the segmentation process is a mixture of more or less large irregular and jagged segments, and unusable fragments. It is therefore necessary to clean this mixture by winnowing and sieving so as to retain only the segments of a suitable size. The segments which are too large and contain two or three kernels should be eliminated, and so should those which are too small and have either no kernel or only a crushed kernel. The segmenter's rate of output is about 100 kgs. per hour.

As we have said, the segments which are retained are irregular in shape and jagged and it is necessary to turn these into a finished product which can be used in seeders. This is carried out by polishing.

The polisher consists of several very fine-grained emery wheels fitted on to a common axis, and enclosed in a casing box which can be tilted at will. The seeds go in through the top of the casing on one side and come out through the other side at the bottom. The polisher's rate of output is lower than that of the segmenter and is about 50 to 60 kgs. per hour. After the seeds have been through the polisher they are dusted and processed so as to obtain adequate germination. Winnowing, sieving, and passing through a densimeter will eliminate both the over large segments with two or three germ-cells, if there should be any, and the empty segments which do not germinate. The total output of the operation is about 40%.

The aim sought in using the segmented seed is to enable mechanized planting and thinning of beets to be carried out.

By sowing with a monoseed seeder, one segment at a time, it is possible to obtain a sufficiently full line of single plants and enable the thinning machine to produce a stand of properly spaced plants, thus avoiding any work by hand.

But to obtain this result it is necessary that the following conditions should be fulfilled at the same time :—

1. Satisfactory germination.
2. Suitable sowings of one seed at a time.
3. Very favourable climatic conditions, to allow for an even sprouting, as the isolated germ-cell of a segmented seed has more difficulty in piercing the crust than do the collected germ-cells of whole seed clusters.

1. Satisfactory germination

In order to achieve this condition it was thought when segmented seeds were first used that it was essential for the seeds to be mostly monogerm. Now it was soon noticed that the criteria—percentage of monogerms and percentage of germination—varied inversely. The more one tried to get a high percentage of monogerms the more difficult it became to obtain good germination (owing to the rough way in which the seeds were segmented). On the other hand, germination in the field proved to be much more monogerm than germination in the laboratory. That is to say, a number of seeds producing two germ-cells each in the laboratory germination bed only gave one viable germ-cell in the soil, therefore becoming monogerm, and a number of segments producing one germ-cell in the bed produced nothing in the soil. Hence a still lower germination.

This is why the present tendency is to have a higher percentage of bi-germs, so as to obtain a better germination.

Technical improvements in preparation, better machines and a less rough treatment of the seeds is being carried out. The ideal to be aimed at is to obtain seed with a 90% germination capacity which would be practically monogerm only.

2. **Suitable sowings : One seed at a time**

In order to fulfil this condition, it was necessary to obtain a product as uniform as possible from the point of view of calibration. Now the only way of obtaining a perfect calibration, and at the same time a regular shape, is to coat the segments, which would then be in the form of small pills of 5 to 8 millimetres in diameter. At first, the coatings did not give good results, as the substance used for the coating should have certain mechanical and physical qualities which are difficult to obtain together. But this process has now been very nearly perfected, and not only does the coating give a faultless shape and calibration to the seeds but covers each segment with a protective envelope, which will put the young plantlet in favourable surroundings at the time of germination.

3. **Favourable climatic conditions**

If the first two conditions are to be found both in America and in European countries, it is not so with the last. The effect of this third condition is more likely to be experienced in the warm and well irrigated areas of the United States than it is over here, even when hasty sowings have not been carried out.

And so as a result of unfavourable climatic conditions (in particular heavy rain which packs the soil after sowing) the sprouting will be uneven, which means that work by machine becomes impossible. It will be necessary to thin out by hand or with a long handled hoe, but this will be greatly simplified and very little thinning out will be necessary when segmented seeds are sown.

To obtain a final crop of 79,800 beets per hectare

(*a*) **With non-segmented seed sowings,** the farm-labourer has to bend down 34 or 35 times per 100 beets left in order to thin out small bunches of 2, 3 or 4 beets, and

(*b*) **With segmented seed sowings,** he has to bend down 18 to 20 times per 100 beets left to remove one beet from where there were two growing.

Therefore even under unfavourable climatic conditions work by hand is simplified.

Saving in Time and Labour

Table 1.

Type of seed	Space in centimetres between two seeds.	Time required for thinning out one hectare.	Saving in labour.
Ordinary seed	2.0	37½ hours	
Segmented seed	2.3	25½ hours	31.9%
" "	3.0	23 hours	38.9%
" "	3.5	21 hours	43.7%

Table II.

Type of seed	Space in centimetres between two seeds	Number of beets over 30 m. immediately after thinning out. (11th June)	Production per hectare.
Ordinary seed	2.0	100	29.325kg
Segmented seed	2.3	92	29.922kg
" "	3.0	88	28.809kg
" "	3.5	80	27.260kg

Remarks on Tables I & II

First let us look at the saving in time. Carefully checked experiments show that with the use of segmented seed there is actually an effective reduction in the labour required. As shown in Table No. 1, hand thinning of one hectare of beets grown from ordinary seed required 37½ hours, whereas the same work carried out on a hectare sown with segmented seed at the average rate of one seed every 23 millimetres required only 25½ hours. If these same seeds were spaced out at 3 centimetres the time required for thinning out would only be about 23 hours per hectare. Finally, when the space between two seeds was as much as 3.5 cm, working hours dropped to about 21 per hectare. The figures we have just given prove that the use of segmented seed actually means a reduction of labour.

It is clear that the extent of this reduction in labour depends also on the quantity of segmented seed sown per hectare. In the experiment we have just described the saving of labour went up from 32% when the seeds were spaced at 23 millimetres to 44% when the space was 35 millimetres. The labourers themselves prefer to work in fields sown with segmented seed, and this for two reasons, firstly because they can work more easily (and therefore earn more money, since they are paid by the hectare and not by the day), and secondly because thinning out is far less hard, as the pulling out of the clumps of plants by hand is greatly simplified. Some labourers use moreover a long handled hoe and only from time to time do they bend down to pull up a few plants with their fingers.

Now let us look at the comparative yields of beet from segmented seed and non-segmented seed. According to Table No. II, which is the result of the previous experiment, we see that ordinary beet seed yields 29.325 kgs. per hectare. When the segmented seeds are spaced at 23 millimetres apart the yield was 29.922 kgs. At 3 cms. apart it was 28.809 kgs. and at 3.5 cms. it was only 27.260 kgs.

If we examine the figures in the column under the heading " number of beets over 30 metres," we can see why the beets from segmented seed planted at three different spacings did not give the same yield. For example, the widest spacing corresponds to 80 beets per 30 metres and a slightly lower yield. It is also interesting to note that over a similar length of 30 metres 92 beets from segmented seed show

a slightly higher yield than 100 beets from non-segmented seed. We think that the explanation of this difference is that when the ordinary seeds are sown very closely in the soil there are so many plantlets that their roots become mutually entangled, and that when these are thinned out, the process of pulling up some of the seedlings by hand damages the roots of those left in the soil. The injury done to them retards their normal development. On the contrary, when segmented seeds are sown in the soil, most of the seedlings are single and their roots do not suffer from the thinning out operation.

We noticed in fact during the above mentioned experiment that the thinning out did not retard the growth of the seedlings from segmented seed, which is not always the case with ordinary seeds.

THE CONTROL OF THE WIREWORM

In France 15 to 20 kgs. of ordinary beet seed is usually sown per hectare. Sowings treated with the mixture of mercury and BHC gamma isomer, ' Ceregam,' are protected from wireworm infestations by an application of 40 grams of gamma isomer per hectare.

On the other hand only 4 to 5 kgs. of segmented beet seed are sown per hectare. If these are treated with the standard ' Ceregam ' the amount of gamma isomer only represents about 10 grams per hectare, that is to say an insufficient quantity.

Tests carried out in France in 1950 and 1951 have shown that a definite protection of the seedlings can be obtained by dusting the seeds with an experimental seed dressing containing 1.5% mercury in the form of methoxy ethyl mercury silicate and 50% gamma isomer at doses varying between 1 to 1.5 kgs. per 100 kgs. of seed. There has been no report of phytotoxicity, although in England phytotoxic damage has occurred at lower rates in certain types of soil.

In certain fields in which there were untreated areas as checks, the treated sowings sprouted normally whilst the checks were very nearly ruined and had to be re-sown.

TECHNICAL BREVITIES

This section includes information on plant protection problems in their widest sense, which has been obtained from published literature. We have given the references to the publications concerned.

INSECTICIDES

CONTROL OF CARPOCAPSA.

CARPOCAPSA, the insect which in the larval stage causes considerable damage to apples and pears in Cyprus by reducing the centres of the fruit to a black mass, causing premature fruit fall and leaving tunnels for the entry of decay organisms, can be readily controlled by the following measures :—

(*a*) Spraying and limewashing the trunk and main branches of the trees in February or March, which kills larvae hibernating in cracks and under loose bark,

(*b*) Placing on the tree trunks at the beginning of June bandages of cloth, sacking or grass to provide a shelter for the chrysalis stage of the insects, which are subsequently destroyed by the removal and burning, deep burying or dipping in boiling water of the bandages every ten days. The bandages are then replaced, and the treatment is continued until a week after picking,

(*c*) Placing on the tree trunks bandages of chemically treated corrugated paper, which kills sheltering insects.

The Countryman, Cyprus, Vol. **V**, *No.* 5, *May*, 1951, *p.* 9.

ORIENTAL PEACH MOTH CONTROL

Two seasons' trials against oriental peach moth, *Ernarmonia molesta*, in Victoria, Australia, show that spraying with 0.1% DDT at intervals of 3 to 4 weeks after the larvae start to feed on the fruit will reduce infestation. Mid-season varieties need only 2 sprayings and late ones 3 or more. Parathion was inferior.

Morris, D. S., J. Agric. Vict., 1950, **48** (12) : 565-7.

RASPBERRY CANE MIDGE AND " MIDGE BLIGHT " CONTROL

In the U.K. raspberry cane midge, *Thomasiniana theobaldi*, is important by paving the way for fungal invasions called " midge blight " to distinguish them from cane blight (*Leptosphaeria coniothyrium*), which is not preceded by insect attack. Most varieties are susceptible. The pest has three generations in the season, and its control prevents

fungal invasion. Soil treatment against overwintering larvae has not been successful. In 4 years of field trials BHC wettable (dispersible ?) powder has given up to 95% control. The recommended treatment is to spray with 0.1% crude BHC in the first week in May (U.K.) when the young canes are 9 to 12 inches high and repeat 10 to 14 days later. Only the young canes need be sprayed and 300 gallons per acre is enough for thorough wetting. No taint is caused to the fruit. DDT is less effective.

Pitcher, R. S., *Grower*, 1951, **35** (15) : 766-7.

PEAR MIDGE CONTROL

In New York State nearly perfect control of pear midge, *Contarinia pyrivora*, was given by one late green tip spray of 50% DDT wettable powder at 2 lb. per 100 gallons, and 15% parathion at 1¼ lb. was very promising. Both were superior to nicotine sulphate.

Mundinger, *F. C.*, *Rep. N. Y. St. Agric. Expt. Sta.*, 1950 : 7.

CHERRY LEAF MINER CONTROL

BHC is the most effective material yet tested for control of the cherry leaf miner, *Profenusa canadensis*, which is a severe pest of Morello cherries in eastern New York. Applied when most of the eggs have been laid and larvae are still small, BHC wettable (dispersible ?) powder (6% gamma) at 3 lb. per 100 gallons or an emulsion concentrate (11% gamma) at 1.5 pt. per 100 gallons can give a complete larval kill. The adult population can be greatly reduced by spraying with the BHC wettable powder at 4 lb. per 100 gallons at pink bud stage and at petal fall.

Hamilton, D. W., *J. Econ. Ent.*, 1951, **43** (5) : 694-6

THE SUSCEPTIBILITY OF THE OAK FLEA-BEETLE TO DDT AND BHC

A report by G. van Rossem that the successful treatment of Oak flea-beetle (*Haltica quercetorum* Foudr.) in strawberry beds in Holland with 5% DDT dust was obviously too expensive for use in woods has prompted the comment by the author of this article that the dust was not used at the lowest effective concentration.

In laboratory tests it has been demonstrated that overwintered adults were completely killed by 0.05% DDT dust, and that still greater dilutions would probably also be effective.

Two BHC dusts of English origin diluted to 0.006% and 0.007% gamma isomer gave complete mortality of adults, the larvae being more resistant.

Fransen, J. J., *Tijdschr. Plziekt.*, **55**, *pt.* 2, *pp.* 92-95. *Wageningen*, 1949. (*Rev. App. Ent.*, *Ser. A.*, **39**, 4, *April* : 1951, *p.* 129.)

GRAPE BERRY MOTH CONTROL

In New York State almost 95% control of grape berry moth, *Polychrosis viteana*, was given by three sprayings of parathion, DDT, or methoxychlor at ½, ¾ and 1 lb. per 100 gallons respectively.

Taschenberg, *E. F.*, *Rep. N. Y. St. Agric. Expt. Sta.*, 1950 : 7.

CALIFORNIA RED SCALE CONTROL

Two sprayings of lemon trees with 25% parathion gave far better control of California red scale, *Aonidiella aurantii*, at 2 lb. per 100 gallons than at 1 lb. per 100 gallons. The effectiveness of oil sprays was greatly increased by the addition of parathion: the light and medium oils were made equally effective; 1% oil and 0.5 lb. of 25% parathion per 100 gallons was superior to the standard treatment of 1.75% medium oil alone; increasing concentration of 25% parathion from 0.5 to 1 lb. + 1 gallon oil per 100 gallons greatly improved control. Addition of 2, 4-D reduced leaf drop.

Cressman, A. W., J. Econ. Ent., 1951, **43** (5): 610-4.

FIG SCALE CONTROL

In California mid May application of 25% parathion wettable powder at 10 oz. per 100 gallons gave as good or better control of the fig scale, *Lepidosaphes ficus*, as the recommended dormant oil sprays. No parathion residue was found in figs 41 days after spraying.

Stafford, E. M., J. Econ. Ent., 1951, **43** (5): 730-1.

CONTROL OF ORANGEWORMS

Orangeworm is the name given to larvae or caterpillars of several species of small moths damaging citrus in certain parts of Southern California. The four most commonly encountered are:—

Orange tortrix—*Argyrotaenia citrana* (Fern)
Pyroderces—*Pyroderces rileyi* (Walsm)
Holcocera—*Holcocera icereyaella* (Riley)
Platynota—*Platynota stultana* (Walsm).

The three materials found most effective for the control of the various orangeworms are cryolite, DDD and parathion, the choice of material depending upon the particular orangeworm to be dealt with. Cryolite is ineffective against *Pyroderces* and does not result in maximum control of the others until about 30 days after application, but the residue remains effective for three to six months. DDD controls all four species, and achieves maximum control in about seven days, its residue remaining effective for 3 to 6 months. Parathion quickly kills all species, reaching the peak of its effectiveness within 2 days with its residual action lasting for about 30 days. The initial high kill, however, often extends its protection to the fruit up to 90 days after application.

This fungicide is limited in its use because of its toxicity to man and domestic animals. Fruit should not be picked until at least 30 days has elapsed after a parathion application.

E. Lawrence Atkins, California Agriculture, **5**, 6, *June*, 1951, *pp.* 4 *and* 15.

SOOTY MOULD ON CITRUS

The Department of Agriculture, Victoria, Australia, has reported the presence in some citrus areas of sooty mould, which is superficial

fungus growth on the leaves and fruit of citrus trees affected with olive scale, soft brown scale, citrus aphis and white fly, upon the sugary exudate of which insects live, covering the leaves and fruit with a black substance. Fruit may thus become unsaleable, resulting in considerable loss to growers.

The cause of the trouble being primarily the insect infestation, the following control measures have been advised :—

For scale insects and white fly, applications of white oil emulsion in March and December at a strength of 1 gallon in 40 gallons of water.

For citrus aphids, application of a spray containing 0.1% DDT emulsion or 0.15% BHC.

" *Farmer and Settler*," *Sydney, Australia*, 30*th March*, 1951.

TOXICITY OF SOME MODERN INSECTICIDES TO THE COFFEE BORER, *HYPOTHENEMUS HAMPEI*.

DDT, BHC, parathion and chlordane were tested in the laboratory and field against the coffee borer, *Stephanoderes* (*Hypothenemus*) *hampei*, with the following results :—

In laboratory tests—A product containing 0.5% gamma isomer of BHC, 0.5% parathion, and chlordane (100%) were equally effective.

In field tests—BHC was much superior to the others.

H. S. Lepage and O. Giannotti, *Arquiv. inst. biol.* (*São Paulo*) 19, 299-308, 1949-50.

(*Abstd. in Chem. Absts.*, **45**, 5, *Mar.* 10, 1951, *p.* 2139.)

BLACK MAIZE BEETLE CONTROL

In South Africa protection of emerging maize seedlings from the black maize beetle (*Heteronychus* sp.) can be obtained by mixing the seed with a 20% BHC dust at the rate of 1 lb. to 20 lb. seed in the planter. Dusting the surface soil with BHC is recommended to protect young plants.

Smit, B., Fmg. S. Africa, 1951, **26** (298), 6.

SWISS TRIALS ON THE CONTROL OF COCKCHAFER WITH BHC AND DDT

Two-year trials carried out in different areas by Wädenswil Research Station, on the treatment of forest margins with BHC and with DDT emulsion by means of mist blowers resulted in a much greater knock-out effect on cockchafers from BHC (8% gamma isomer at 7.5%) than from the DDT emulsion (20% DDT at 10% or 50% DDT at 5%). Recovery of some dropped beetles after both treatments was much more marked after DDT applications. The beetles were activated by a sub-lethal dosage of DDT, resulting in their mass flight and settling in other places, such as orchards. Applications by helicopter seem necessary for effective control of the pest under certain conditions, but the danger of destroying useful insect fauna at the same time must be borne in mind.

Schneider, F. Schweiz, Z. Obst.—u. Weinb. 1950, **59** : 396-405, 425-31. (*Abstd. in Hort. Absts.*, **21** : 1 : *Mar.*, 1951, *p.* 51).

WHITE GRUB CONTROL ON SEEDLING CONIFERS

Greenhouse tests in New York State showed that soil applications of BHC, chlordane and parathion, at 5 lb. gamma isomer, 20 lb. and 15 lb. respectively, effectively killed second and third instar grubs without appreciable injury to young rooted cuttings and seedlings of yew, arbor vitae, juniper, hemlock, Douglas fir and other conifers.

Gambrell, F. L., Rep. N. Y. St. Agric. Expt. Sta., 1950 : 8.

CERTAIN PRELIMINARY STUDIES IN THE CONTROL OF CARDAMOM THRIPS

The most important insect pest attacking Cardamom (*Elettaria cardamomum*) in India is the Cardamom thrips (*Taeniothrips cardomomi*), which, in some years, ruins the entire crop. Studies on the efficacy of various control methods, which have extended from 1946-48, have shown that the most effective treatments, from the point of view of higher yields and low thrip infestation, are :—

1. Dusting with " Gammexane " D.025 at the rate of 3 lb. per acre every month.

2. Spraying with nicotine sulphate at monthly intervals at a concentration of 0.05 per cent and at the rate of 20 gallons per acre.

M. S. Subbiah, Agric. Res. Inst. Combatore, Indian Farming, Calcutta, May, 1950, *pp.* 183-6.

COTTON PEST CONTROL : STATUS IN U.S.A. IN 1951

The standard dust for cotton insect control is still 3% gamma BHC and 5% DDT and 40% sulphur. DDT is the best material against bollworm and pink bollworm, and if infestations are heavy a 2-10-40 mixture is recommended. The BHC in the mixture may be replaced by 20% aldrin or 1.5% dieldrin, or both BHC and DDT may be replaced by 20% toxaphene, but such mixtures are less effective against cotton aphid. Shortage of sulphur may necessitate the use for red spider control of 10 to 15 lb. per acre of a 1% parathion dust or sprays of 40% TEPP at $\frac{1}{2}$ pt. per acre or Aramite at 1/3 lb. per acre. Spray recommendations for general use are $\frac{1}{2}$ lb. DDT with either 1/3 lb. gamma BHC or $\frac{1}{4}$ lb. aldrin or 1/5 lb. dieldrin, alternatively toxaphene may be used alone or in a 2 : 1 mixture with DDT.

Systemic insecticides cannot yet be recommended, but in laboratory tests octamethyl pyrophosphoramide applied to the soil at 4 to 8 lb. per acre caused cotton plants to remain toxic to aphids and spider mites for several months, and foliage spraying at 1 lb. per acre protected for up to a month. When seed was treated with 1 lb. of chemical to 100 lb. seed the seedlings were toxic to aphids and mites for six weeks. Treatments were ineffective against other pests.

Acco Press, 1951, **29** (3) : 1-34.

PEA AND BEAN WEEVIL CONTROL ON LUCERNE LEYS

The Grassland Research Station, Stratford-on-Avon, U.K., use a 5% DDT dust at 30 lb. per acre as routine treatment of lucerne

and clover leys against pea and bean weevil, *Sitona lineatus*. Application is made as soon as the seedlings emerge. If heavy rain follows the first dusting a second and even a third may be given.

Davis, W., Agriculture, 1950, **57** (7) : 308-9.

BHC AND DDT SAVE UNION'S CROPS

In a record season for insect pest infestation of crops in South Africa, partly because of abundant rains in many parts of the country and partly because of the large areas under crops, the insecticides, benzene hexachloride and DDT, have saved the situation for farmers, according to Dr. Bernard Smit of the Division of Entomology, Department of Agriculture, Pretoria.

Pests which were successfully controlled include the brown locust, and insects attacking castor oil, Indian hemp, chicory, peanuts and sweet potatoes, and the maize stalk borer, against which DDT was the specific antidote. It is estimated that a loss of about £25,000,000 would have been involved in the destruction of crops if the brown locust had not been controlled.

"*Farmer's Weekly*," *Bloemfontein, South Africa*, 21*st March*, 1951.

REMOVING SPRAY RESIDUES FROM TOMATOES

The arsenic spray and dust residues which tend to stick in cracks and furrows on the surface of tomatoes can be effectively removed by the following chemical treatment :—

The fruit is placed in a wooden case, the boards of which are so spaced as to permit rapid penetration and drainage of liquid and equipped with sloping draining boards. The case containing the tomatoes is then dipped for 1½ minutes in an acid solution consisting of one quart commercial hydrochloric acid in 25 gallons of water, moving the case up and down to wet all the fruit.

The fruit is then drained and plunged for 1 minute into a lime dip made up of ¾lb. hydrated lime in 25 gallons of water to neutralise any acid left. After draining again, the fruit is thoroughly washed in clean water and dried thoroughly before packing.

35 bushels of tomatoes with heavy spray residues can be effectively treated with 25 gallons of the dip.

"*The Banana Bulletin*," **14**, 5, *p.* 10, *Sydney, May*, 1951.

MEADOW SPITTLEBUG CONTROL WITH LOW AND HIGH VOLUME INSECTICIDE APPLICATIONS

Excellent control of meadow spittle bug (*Philaenus leucophthalmus*) nymphs was obtained in Ohio by spraying with BHC at 0.2 lb. gamma isomer per acre in 37 and 100 gallons of spray mixture, even when applied to foliage 12 inches high, yields of a mixed meadow crop being increased from 22 to 48 per cent, by this treatment. Following this rate of application of gamma BHC per acre there was sufficient residual action to control 98 per cent. of the nymphs, including those hatching after treatment.

Toxaphene at 1.5 lb. per acre applied in either high or low volume sprays also gave excellent control of spittle bug nymphs when the plants were less than eight inches high.

The efficacy of the insecticides in the control of spittle bug nymphs was apparently not reduced by rain immediately following application.

C. R. Weaver, Ohio Agric. Expt. Station, Wooster, Jour. Econ. Ent., **44**, 2, *Apl.*, 1951, *pp.* 163-6.

LOCUST CONTROL IN URUGUAY

A successful campaign against locust (*Schistocera*) swarms which invaded Uruguay from the west and north in May, 1947, was carried out by mobile squads with motor transport and aeroplanes for scouting. The methods employed included dusting with 12% technical BHC—containing 12-13% gamma isomer—against the adults (the principal measure) and spraying with 3.5-5% BHC, distributing baits poisoned with BHC and other toxicants and using flame-throwers against the hoppers. By these means, aided by the use of barriers to surround hopper bands prior to their destruction rather than to protect crops, the locusts were prevented from causing damage and were completely controlled in five months.

Murguia, J., Publ. Direcc. Agron. Uruguay, No. 92, 64 *pp., Montevideo*, 1948.

(*Rev. App. Ent. Ser. A.*, **39**, 4, *Apl.*, 1951, *p.* 97.)

LOCUST CONTROL: USE OF HEXACHLOROCYCLOHEXANE AND TECHNICO— ECONOMICAL COMPARISON OF THREE METHODS OF EMPLOYMENT

Field tests, in which locusts (*Dociostaurus maroccanus*) were controlled with benzene hexachloride containing 20% of the gamma isomer in various combinations of fillers and bait materials, yielded the following data :—

With soil as a filler, 15 quintals of a mixture containing 5-7% toxicant were required per hectare ;

With bentonite, 1 quintal of a mixture containing 30-35% toxicant per hectare,

With bran, 3.5 quintals of a mixture containing 1.2% toxicant per hectare.

Bentonite as a filler preferably with bran as a bait is recommended ; such a mixture should give as good results at 35 kg. per hectare as the soil mixture at 75 kg. per hectare.

Ann. sper. agrar. (*Rome*) (*N.S.*), **4**, 869-90 (1950).

(*Abstd. in Chem. Absts.* 45 : 6 : *Mar.* 25, 1951, *p.* 2620.)

CONTROL OF SOME SOIL-BORNE DISEASES OF PLANTS BY FUNGICIDES APPLIED TO THE SOIL IN FERTILIZER

Experiments in Massachusetts have shown that certain fungicides can be safely, effectively and conveniently applied to soil in commercial fertilizers. This method has given better control of damping-off than the application of the products to soil in water.

The following results were obtained against specific diseases :—

Club root of cabbage was controlled by Hg_2Cl_2 (0.2 or 0.3 grm. per sq. ft.) in fertilizer added to soil which had received 20-30 grm. hydrated lime per sq. ft. Addition of NaCl to the soil improved the effectiveness of the fungicide, but much less so than the addition of hydrated lime. The addition of sulphur to the soil lessened its effectiveness.

Onion smut was controlled by the application of 2.75 grm. per sq. ft. of $NaNO_2$ 3 days before seeding, 3.0 grm. of $CaNO_2$ or KNO_2 10 days before seeding, Fermate 0.5 to 1.0 grm., 2 to 10 days before seeding. The percentage of smut was reduced by Fermate fertilizer mixture. 'Arasan' controlled smut and damping-off and, when used for treatment of seeds, gave better results against smut than Fermate.

Damping-off of egg-plant, pepper, beet, cucumber and tomato was controlled by Phygon (2, 3-dichloro-1-4-naphthoquinone) applied to soil fertilizer. Tomato, cucumber and beet stands were also improved by Dithane D-14, Dow seed Protectant No. 9 (Zn 2, 4, 5-trichlorophenate), MTD (Morpholine thiuram disulphide), and Tuads (tetramethyl thiuram disulphide) similarly used.

$K_2Cr_2O_7$—graphite mixture gave good results as a seed treatment.

Wm. L. Doran, Mass. Agr. Expt. Sta. Bull., **455**, 2-28 (1950).
(*Abstd. in Chem. Absts.*, **45**, 5, *Mar.* 10, 1951, *pp.* 2129-30).

CHEMOTHERAPEUTIC CONTROL

Experiments on the control of red stele disease of strawberry, caused by *Phytophthora fragariae*, by soil applications of disodium ethylene bis-dithiocarbamate (Dithane D-14) have produced evidence that the chemical acted therapeutically, after absorption by the plants, rather than as a soil sterilizer. A new approach to the control of root diseases is thus illustrated.

This conclusion is drawn from the fact that control of the disease was achieved by treating plants grown in sand with Dithane D-14 and subsequently planting them in infested untreated soil without further treatment, whereas only 10 per cent of the check plants grown in untreated soil remained healthy.

E. M. Stoddard, Connecticut Agric. Expt. Sta., Phytopathological Abstracts, January, 1951, *and Agric. Chemicals*, **6**, 6, *June*, 1951, *p.* 73.

HOW TO CONTROL PEAR RUST

Spraying with 1 per cent. Bordeaux mixture or equivalent commercial copper preparations during a period from bud burst to about one month later is advised for the control of pear rust (*Gymnosporangium sabinae*) in Turkey, as the eradication of the alternative host, *Juniperus* (*sibirica*) is impracticable, protective measures are difficult to apply, and severe infections of pear trees remote from junipers have been observed.

Bremer. H, and Göksel, N., *Maksul Hekimi* (*Plant Prot. Jour.*), **3**, 9, *pp.* 209-212, 1950. (R.*A.M.*, **30**, 3, *Mar.* 1951, *p.* 170).

CONTROL OF BLISTER BLIGHT OF TEA

' Perenox ' and Copper Sandoz sprays, when repeated at intervals of 7 to 10 days during the epidemic period, gave the best results in spraying experiments against blister blight. Further work is in progress.

Hainsworth, E., Plant Pathological Branch, Rep. Tocklai Expt. Sta., Indian Tea Assocn., 1948, *pp.* 26-31 (? 1949). (R.*A.M.*, 30, *part* 3, *Mar.* 1951, *p.* 126).

CONTROL OF BLISTER BLIGHT

The Tea Research Institute of Ceylon, in their circular B.B/2, has described the recent practical experience of a Ceylon planter, Mr. A. R. Williams, in the protective spraying of mature tea against Blister Blight.

The equipment used was a battery comprising 12 boom sprayers with charging pump and 6 Kent Sprayers (all made by the Four Oaks Spraying Machine Company Ltd.) the former type being found the more economical, and the fungicide applied was ' Perenox ' (4 oz. to 10 gall. water), at the rate of 16 to 17 gallons per acre. Very good results have been obtained elsewhere with a weaker solution of ' Perenox.'

The contrast between the sprayed and the unsprayed areas in crop yield as well as in appearance was reported as being most satisfactory. Analysis of tea for copper content has shown figures well below the permissible level.

It is stressed that good supervision when spraying is very important and, in order to sustain interest during a long period of wet weather, it is a great advantage to have a machine that can spray large acreages efficiently in a few hours, and therefore need only be used occasionally.

" *The Planters' Chronicle*," *Vol.* 46, *No.* 7, *Apl.* 1, 1951, *pp.* 176-179.

DAMPING-OFF OF COFFEE SEEDLINGS

Damping-off, or " mal de talluelo" (small stem disease), of coffee seedlings often causes heavy losses in El Salvador. The disease usually develops 10 days after germination and has been effectively controlled by weekly applications with 48 per cent wettable ' Spergon '

or Yellow Cuprocide (18 grm. and 45 grm. respectively to 2 gallons per 24 sq. ft.), started as soon as the disease was observed.

After the 'Spergon' treatment the cotyledons, if open, were rinsed with water. Some control of unspecified leaf spot diseases was obtained if Yellow Cuprocide was left on the cotyledons. 'Perenox,' at 60 grm. to 2 gallons per 24 sq. ft., has been substituted for Yellow Cuprocide.

Crandall, B. S., Plant Dis. Reptr., **34**, 9, *p.* 263, 1950 (*R.A.M.*, **30**, *part* 4, *Apl.*, 1951, *p.* 193).

CACAO DISEASES.

The mycology section, West African Cacao Research Institute, Tafo, Gold Coast, reports that in the 1948 main crop the ratio of number of cacao pods per pound of wet beans was not affected by pod-spraying at weekly intervals with Bordeaux mixture, 'Perenox,' and nicotine sulphate. Bordeaux reduced the incidence of black pod (*Phytophthora palmivora*) to 4.5% compared with 12.5% for the unsprayed pods, and 'Perenox' was found to be the best treatment for *Botryodiplodia theobromae*. In Costa Rica, where black pod is more widespread owing to the heavier rainfall, spraying of cacao tree canopies is practised to reduce reservoirs of the fungus.

Ann. Report W.A.C.R.I., Apl., 1948 *to March*, 1949. 1950. (*R.A.M.*, **30**, *part* 4, *Apl.*, 1951, *pp.* 218-19).

WEEDKILLERS AND HORMONE PRODUCTS

WEED CONTROL IN GRAIN CROPS

A. G. Street records marked success this year (1951) in Great Britain in spraying some 20 acres of his grain crops against weeds, which method of weed control he has found to be much cheaper and much more efficient than any other. He reports that the customary spray against charlock completely kills that weed and effectively checks docks and thistles. The spray against chickweed, though more expensive, seems to kill every weed in the crop. In both cases the effect appeared to be as beneficial to the grain crop as 1 cwt. per acre of nitrogenous fertilizer.

A. G. Street, "*I'm An Open Air Man*," *The Farmer's Weekly*, **34**, 26, *June* 29, 1951, *p.* 49.

WEED CONTROL IN CEREAL CROPS

Experiments on the control of a bad infestation of wild radish (*Raphanus raphanistrum*) in wheat were carried out in Tasmania with the following treatments :—

1.5% DINOC (sodium dinitro-o-cresylate) (1) with and (2) without 4 lb. per acre ammonium sulphate, and (3) with 0.1% 'Methoxone' (2-methyl-4 chlorophenoxyacetic acid), at 120 lb. per acre, and (4) with 1% 'Methoxone' dust at 200 lb. per acre. (2) and (3) above gave 50% and 100% kills respectively, and were the most effective

treatments. Dinoc alone was inferior to Dinoc-ammonium sulphate and ' Methoxone ' dust acted too slowly. All treatments increased wheat yields as follows :—

(3)	112%
(1)	84%
(2)	38%
(4)	20%

J. Tilt, Tasmanian J. Agric. 18, 169-71 (1947) (*Chem. Absts. Easton, Pa., 25th April,* 1951).

ONTARIO HIGHWAYS FIGHT RAGWEED

Ragweed (*Ambrosia* spp.) was very satisfactorily controlled by both the ester and amine formulations of 2,4-D at 1.5 lb. acid equivalent per acre.

" *Down to Earth,*" 1950, **6** : 1 : 5. (*Abstd. in Hort. Absts.* **21** : 1 : *Mar.*, 1951., *p.* 63).

EXPERIMENTS ON WEED CONTROL WITH ' AGROXONE ' IN BRITISH GUIANA

' Agroxone,' especially with addition of 2% of strong soap solution, gave excellent control of wild eddo (*Caladium sp.*) in trials at Sophia Sugar Experiment Station. Preliminary trials suggest that two sprayings, 6 to 8 weeks apart, each at the rate of 2 gallons ' Agroxone ' per acre, using a 1 in 100 spray solution plus 2% soap solution as spreader, will result in virtually complete and economic control of the weed. Pre-emergence sprays of ' Agroxone ' have given promising results against other weeds.

Stevenson, G. C., Proc. 1948 *Mtg., B.W.I. Sugar Tech., Barbados, pp.* 62-5. (*Abstd. in Hort. Absts.*, **21**, 1, *Mar.*, 1951, *p.* 65).

SPRAY METHOD TO KILL THE WEED—PAMPAS LILY

Pampas Lily of the Valley (*Salpichroa rhomboidea*) can only be successfully controlled by poisoning by using ' Methoxone,' which may have to be sprayed on twice and, in some places, three times because of the deep-seated tubers. Several gardeners have used this method of eradicating the weed with success, when even trenching failed. ' Methoxone ' at a dilution rate of 1 pint to the gallon will in time kill the plant completely.

" *Suburban Gardener* " (*South Oakleigh*), *Melbourne Leader, Australia, 28th April,* 1951.

MOVEMENT OF 2,4-D IN SOIL

An experiment in which the movement of 2,4-D in soil following different amounts of rainfall was studied showed clearly that, in a calcareous soil with a high organic matter content, sodium 2,4-D does not move beyond the surface inch even though heavy rain falls.

Certain other soil types may have a similar effect on the herbicide. This information may be useful when the pre-emergence application of 2,4-D is contemplated.

T. J. Muzik, A. J. Loustalot and *H. J. Cruzado, Agronomy Journal*, **43**, 3, *pp.* 149-50, *March*, 1951.

WEED CONTROL STUDIES ON SUGAR BEET

In Oregon, U.S.A., pre-emergence application of suitable chemicals has been found to be one of the best means of solving the problem of weed control in sugar beet plantations as the crop is very limited in its tolerance to weedkillers. Dinitro alkyl phenols with diesel oil gave promise of being satisfactory for this purpose. IPC is very promising for the control of grass in autumn planted beet, which have shown considerable tolerance to this chemical after passing the four-leaf stage. Soil moisture is the most important limiting factor in the use of IPC on beet, as if there is a deficiency IPC has little or no effect.

Virgil H. Freed and Ray A. Pendleton, Proc. Amer. Soc. of Sugar Beet Technologists, 1950, *pp.* 459-462.

SOME EFFECTS OF PLANT GROWTH REGULATORS ON BOLTING AND OTHER RESPONSES OF SUGAR BEETS

Experiments carried out in California in 1947 and 1948 indicated that foliage sprays containing a low concentration of 2,4-D delay bolting of sugar beets, though in some cases the treatment lowered sucrose content of the roots. Further studies are necessary before growers' trials could be recommended.

Charles Price, William S. Stewart, and Louis C. Erickson, Proc. Amer. Soc. of Sugar Beet Technologists, 1950, *pp.* 130-136.

SELECTIVE WEEDKILLERS

Various trials of rates and methods of application of MCPA and 2,4-D in Great Britain using various machines showed (*a*) that yarrow and clover were resistant, (*b*) grass seed will germinate shortly after 2,4-D treatment, but normally a lapse of 2-4 weeks is necessary after using MCPA. The possible value of these herbicides in freeing top dressings of weed seeds is under investigation. Greenness of grass is deepened by the use of MCPA and 2,4-D, which, however, when applied to weed inflorescences, have no effect on seed already formed.

Escritt. J. R., J. Bd. Greenkeep. Res., 1949, **7**, 213-23. (*In Herbage Absts.*, **20**: 4, *Nov.* 1950, *p.* 206).

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